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TECHNIQUES FOR APPRAISING THE ENERGY ECONOMY AND OUTLOOK IN LESS DEVELOPED COUNTRIES

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TECHNIQUES FOR APPRAISING THE ENERGY ECONOMY AND OUTLOOK IN LESS DEVELOPED COUNTRIES

by

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1. The purpose of this paper is to outline one approach to energy planning and forecasting and discuss its applicability to the less developed countries of the world.

2. The approach consists mainly of the construction of a complete energy balance for the country under consideration; appraisal of the influence of various physical, economic and institutional factors upon this balance; and application of the understandings thereby gained to the problems of planning and forecasting.

3. The energy balance is a device that has proven particularly useful in the collection and organization of data on the physical aspects of the energy economy. It is in fact nothing more or less than a consolidated account for all sources of energy, in which the several sources used in a particular area during a stipulated period of time are expressed in a common unit and brought together in a single table or graph. Fully developed, the energy balance traces each source of energy from origin to effective use, showing at each stage in this flow the physical and functional interrelationships of the several energy sources.

4. This analytical tool has come into rather wide use during the past decade, but mainly for countries that get most of their energy from sources that enter normal trade channels and are duly recorded - that is, the so-called commercial sources of energy. Among these countries are Austria[1], Belgium[2], Bulgaria[3], Canada[4], Germany[5], Italy[6], the Netherlands[7], Spain[8], and the U.S.A.[9].

5. There is at least one case, however, in which an energy balance has been constructed for a country that depends primarily upon non-commercial sources of energy. This case is India, whose energy balance is shown graphically in Figure I, and statistically in Table 1 appended to this paper[10].

6. The chart and the table demonstrate the importance of non-commercial sources of energy, including even draft animals, in less developed countries. In this particular case, it should be noted that draft cattle provide nearly as much power as all other sources of energy combined, and non-commercial fuels, such as firewood and dung, more heat than all other sources of energy combined.

7. The main point in presenting the chart, however, is to demonstrate that energy balances can be constructed for less developed countries when needed. So far as commercial sources of energy are concerned, it is, in fact, somewhat easier to prepare accounts for less developed than for developed countries. The volumes to be accounted for are smaller; the flow from production or imports to end-use is ordinarily simpler; and the pattern of distribution is usually less diverse.

8. On the other hand, balances for less developed countries are complicated somewhat by the necessity of including non-commercial sources of energy, especially when the work output of draft animals must also be taken into account. This is not as difficult as it may seem, for supply and demand of energy from these sources can be estimated, with accuracy that suffices for most purposes, by methods developed in the Statistical Office of the United Nations[11] and the U.S. Department of State[12].

9. The most difficult problem that arises, in both developed and less developed countries, is that of estimating the quantities of energy effectively used - that is, the amount of energy converted to useful heat, light or power. The importance of this calculation cannot be over-emphasized, because the real costs of energy are determined as much by efficiency of use as they are by prices. Diesel oil, for example, is far more expensive per unit of contained energy than is coal, but as a locomotive fuel it costs less than coal per unit of work performed because of the relatively high efficiency with which it is used.

10. Reasonable approximations of effective use, satisfactory for most purposes, can be obtained by the application of standard efficiency factors to data on energy supplied to various consumer groups. The efficiency factors needed can be obtained from any one of a number of studies such as the United Nations paper on World Energy Requirements in 1975 and 2000[13], and the papers previously referred to in footnotes 2, 6, and 9. Standard factors such as these can sometimes be improved upon, however, by special surveys of combustion practices and results[14].

11. National energy balances such as those described above provide most of the data needed concerning physical aspects of the energy economy, especially where the country dealt with is small. In large countries such as India, these can be usefully supplemented by regional energy accounts, especially when patterns of energy supply and demand vary significantly from one region to another.

12. The usefulness of both national and regional accounts is considerably enhanced when they can be repeated for a series of years, thus affording a basis for computing historical rates of growth in production, consumption, or other phases of supply and demand.

13. For planning purposes, data on energy reserves are needed, especially data on the location of mineral fuel deposits and water power sites that are readily accessible to domestic markets and can be developed at relatively low cost.

14. Energy balances provide a useful panorama of the energy situation. When repeated for a series of years and supplemented by data on energy reserves, they also provide some understanding of why the energy economy operates as it does. For a more complete understanding, it is necessary to consider also certain other factors which affect the energy economy - economic and institutional factors in particular.

15. Costs are among the factors to which particular attention must be given - mainly costs to consumers, but also costs to the economy as a whole and costs to the country in foreign exchange.

16. Data on costs appear to be relatively rare, but a surprising volume of such data can be assembled through systematic research within the area under study. In India, for example, it was found possible to obtain data on the costs of energy to industrial establishments, railways, power systems, households, airlines, gas works, and motor vehicle operators. It was also found possible to obtain data on pithead prices of coal, on prices of petroleum products at refineries and distribution depots, on costs as well as charges for moving coal by rail, on charges for moving fuels by ship, on the aggregate values of fuels imported and exported, and on taxes on petroleum products

and coal. Altogether, enough data were available to reveal the structure of energy costs in each sector of the economy and each major portion of India.

17. Institutional factors that affect the energy economy include the agencies responsible for managing portions of the energy economy; the instruments through which control is exercised, such as price controls, taxes, and subsidies; and the will of the government and the people to develop the national economy.

18. Data on institutional factors are not sought through separate research, but are accumulated in the course of normal research on physical and economic aspects of the energy economy. Some, such as taxes and subsidies, are brought to light through studies of the structure of prices or costs. Others are indicated simply by deviations of the supply-demand pattern from its expected course. As a rule, institutional factors tend to stand out in the publicly operated branches of the energy economy, and to fade into the background under private enterprise.

19. With data on the physical, economic and institutional aspects of the energy economy in hand, an analysis of the energy situation becomes possible. This appraisal can be addressed initially to the single question: are consumers getting the energy they require? If they are not, there is need for immediate action to find out why not and what can be done to see that they get what they need practically regardless of cost. The penalty paid for any energy shortage normally exceeds by far, in terms of production, the costs of energy itself.

20. As a rule, it is fairly easy to find out whether consumers are getting the energy they require. Shortages, when they occur, have rather dramatic consequences, such as the closing down of industrial establishments, rationing, load shedding, and rapidly rising prices. They are therefore likely to be given considerable prominence in the press and other news media.

21. Attention must also be focussed on the costs of energy to consumers, to the economy as a whole, and to the country. Costs to the economy as a whole may be defined as consumer costs adjusted upwards to correct for subsidies and downwards to correct for taxes. Costs to the country may be defined as the net gains or losses in foreign exchange that result from the purchase of energy from foreign sources.

22. It is relative costs that are important to consumers and to the economy as a whole. The real question is one of whether energy is being made available to the two groups at as low a cost as possible, taking into account relative efficiencies of use as well as relative prices of the several energy sources. As previously indicated, the importance of taking efficiencies of use into account cannot be overemphasized.

23. The appraisals described above will have brought to light many of the problems and opportunities facing the energy economy. They will thereby have created a sound basis for energy planning, the objective of which is to maximize the contribution of energy to the development of less developed areas.

24. A somewhat different approach is needed for forecasting, because forecasting is concerned with things as they are likely to be rather than things as they should be.

25. One basis for forecasting is provided by data on historical trends in demand or supply of energy. The value of such data is extremely limited, however, because of potential changes in the fuels used and in the efficiency with which they are used. As a rule, the main value of trend data is in indicating probable upper and lower limits to the development of supply or demand.

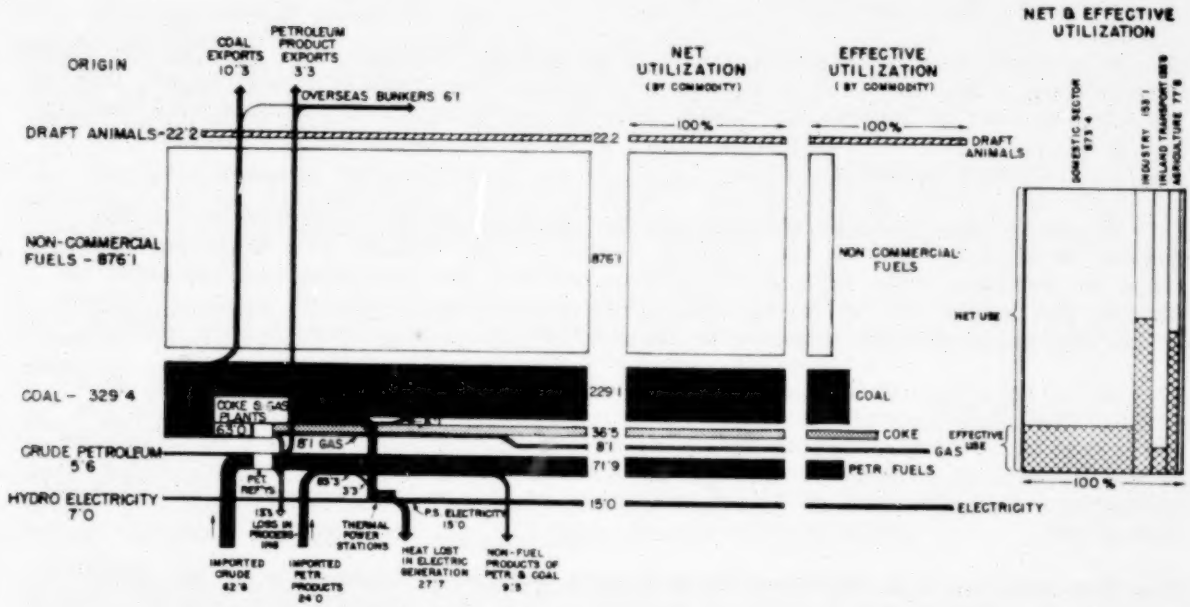
26. Forecasts of national product also provide a basis for estimating future needs and supplies of energy, but only on the basis of the historical relationship of energy to national product. The results obtained by this device are no more satisfactory than simple projections of the energy curves.

27. To get really satisfactory forecasts it is necessary to take into account, in addition to historical trends, various economic and institutional factors that influence energy demand and supply. The real problem is to ascertain how much weight should be given to each of the factors affecting demand or supply. In private enterprise economies, where economic forces have relatively free play, the pendulum is likely to swing toward economic factors. In public enterprise economies, institutional factors are more likely to dominate. But there is no hard and fast rule to guide the forecaster. He must, finally, weigh intuitively that which he cannot weigh mathematically.

FIGURE I

ORIGIN AND UTILIZATION OF ENERGY IN INDIA — 1959

(DATA IN MILLION MEGAWATT HOURS ELECTRICITY EQUIVALENT)



FOOTNOTES

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6. Societa Edison, Il balancio energetico Italiano nel 1960, Quaderni di studi e notizie, 343, Milan (16 July, 1961).

7. Netherlands. Centraal Planbureau, Production and consumption of energy in the Netherlands in 1947, The Hague. (Chart.)

8. Spain. Ministerio de Industria, Balance y estructura de la produccion y el consumo de energía en Espana, Madrid (1956).

9. Barnett, Harold J. Energy Uses and Supplies: 1939, 1947, 1965. Washington: GPO, 1950. Department of the Interior, Bureau of Mines, Information Circular 7582.

10. The chart and table are based on studies prepared in 1961 by the National Council of Applied Economic Research, New Delhi.

11. United Nations. Statistical Office, World energy supplies in selected years, 1929-1950, Statistical papers, J-1, New York (September, 1952).

12. U.S. Department of State, Energy resources of the world, U.S. Government Printing Office, Washington (1949).

13. United Nations. Department of Economic and Social Affairs, World energy requirements in 1975 and 2000, International Conference on the Peaceful Uses of Atomic Energy: Proceedings, I, New York (1956).

14. A good example of such surveys is the survey of household fuel efficiencies conducted for the National Council of Applied Economic Research in India and reported upon in Domestic fuels in India.

TABLE I

INDIA'S ENERGY BALANCE, 1959

(In Million MWH Electricity or Equivalent)

	Coal	Coke	Coal Gas	Crude Oil	LPG	Avgas	Je Fuel	Mogas	Kero	Dist. F/O
Primary Production	329.4	-	-	5.6	-	-	-	-	-	-
Secondary Production	-	42.5	8.1	-	0.1	-	-	12.2	9.5	17.7
Net import	-9.7	-0.5	-	63.1	-	1.1	1.8	-1.8	14.7	2.8
Gross Consumption	319.7	-0.5	-	68.7	-	1.1	1.8	-1.8	14.7	2.8
Overseas Bunkers	1.0	-	-	-	-	0.3	0.3	-	-	0.3
Gross Inland Consumption	318.7	-0.5	-	68.7	-	0.8	1.5	-1.8	14.7	2.5
Processed in										
Coke Ovens	43.3	-	-	-	-	-	-	-	-	-
Gas Works	1.3	-	-	-	-	-	-	-	-	-
Soft Coke Works	18.7	-	-	-	-	-	-	-	-	-
Petr. Refineries	-	-	-	68.7	-	-	-	-	-	-
P.S. Elect. Works	32.2	-	-	-	-	-	-	-	-	1.3
Total	95.5	-	-	68.7	-	-	-	-	-	1.3
Net Inland Consumption(1)	229.1	(2) 36.5	8.1	-	0.1	0.8	1.5	10.4	24.2	18.9
Utilisation (Input)										
Transportation	108.8	-	-	-	-	0.8	1.5	10.4	-	13.3
Industry	95.3	21.9	7.8	-	-	-	-	-	-	2.9
Domestic Sector	4.8	13.1	0.3	-	0.1	-	-	-	23.7	-
Agriculture	6.4	-	-	-	-	-	-	-	0.5	2.7
Non-fuel	-	1.4	-	-	-	-	-	-	-	-
Lost & Not Acct'd	13.8	0.1	-	-	-	-	-	-	-	-
Total	229.1	36.5	8.1	-	0.1	0.8	1.5	10.4	24.2	(3) 20.2
Utilisation (Output)										
Transportation	6.8	-	-	-	-	0.1	0.2	1.0	-	0.8
Industry	52.4	12.0	6.2	-	-	-	-	-	-	0.9
Domestic Sector	1.4	3.9	0.2	-	0.1	-	-	-	1.6	-
Agriculture	2.5	-	-	-	-	-	-	-	0.1	0.5
Total	63.1	15.9	6.4	-	0.1	0.1	0.2	1.0	1.7	3.2
Heat	58.0	15.9	6.4	-	0.1	-	-	-	1.2	-
Power & Light	5.1	-	-	-	0.1	-	0.2	1.0	0.5	3.2

TABLE I (Continuation)

	Resid F/O	Ref.Fuel &Loss	Non-fuel Products	P.S. Elect	All comm. Sources	Non-comm. Fuels	Inanimate Sources	Draft Power	All Sources
Primary Production	-	-	-	7.0	342.0	876.1	1,218.1	22.2	1,240.3
Secondary Production	19.9	4.0	4.3	8.0	126.3	-	126.3	-	126.3
Net Import	-1.5	-	3.7	-	73.7	-	73.7	-	73.7
Gross Consumption	- 1.5	-	3.7	7.0	415.7	876.1	1,291.3	22.2	1,314.0
Overseas Bunkers	4.3	-	-	-	6.2	-	6.2	-	6.2
Gross Inland Consumption	-5.8	-	3.7	7.0	409.5	876.1	1,285.6	22.2	1,307.8
Processed In									
Coke Ovens	-	-	-	-	43.3	-	43.3	-	43.3
Gas Works	-	-	-	-	1.3	-	1.3	-	1.3
Soft Coke Works	-	-	-	-	18.7	-	18.7	-	18.7
Petr. Refineries	-	-	-	-	68.7	-	68.7	-	68.7
P.S.Elect.Works	2.1	-	-	-	35.6	-	35.6	-	35.6
Total	2.1	-	-	-	167.6	-	167.6	-	167.6
Net Inland Consumption	12.0	4.0	8.0	15.0	368.7	876.1	1,244.8	22.2	1,267.0
Utilisation (Input)									
Transportation	0.8	-	-	0.5	136.1	-	136.1	1.0	137.1
Industry	10.7	4.0	-	9.0	151.6	1.5	153.1	-	153.1
Domestic Sector	-	-	-	2.7	44.7	828.7	873.4	-	873.4
Agriculture	0.6	-	-	0.7	109	45.9	56.8	21.2	78.0
Non-Fuel	-	-	8.0	-	9.4	-	9.4	-	9.4
Lost & Not Acct'd	-	-	-	2.1	16.0	-	16.0	-	16.0
Total (4)	14.1	4.0	8.0	15.0 (5)	372.0	876.1	1,244.8	22.2	1,270.3(5)
Utilisation (Output)									
Transportation	1.0	-	-	0.5	11.4	-	11.4	1.0	12.4
Industry	6.4	2.4	-	-2.0	78.3	0.6	78.9	-	78.9
Domestic Sector	-	-	-	1.4	8.6	124.3	132.9	-	132.9
Agriculture	0.3	-	-	0.7	4.1	13.8	17.9	21.2	39.1
Total	7.7	2.4	-	0.6	102.4	138.7	241.1	22.2	263.3
Heat	6.7	2.4	-	13.8	76.9	138.7	215.6	-	215.6
Power & Light	1.0	-	-	14.4	25.5	-	25.5	22.2	47.7

(1) Including 5.6 from oven coke and 0.4 accounting difference
(2) Excluding 6.3 transfered to coal/soft coke; including 0.7 transferred from oven coke
(3) Including 1.3 converted to electricity
(4) Including 2.0 converted to electricity
(5) Including 3.3 converted to electricity

LPG-Liquefied Petroleum Gas
Mogas-Motor Gasoline
Dist.F/O-Distillate Fuel Oil
Ref.Fuel&Loss-Refinery Fuel & Loss
All Comm.Sources-All Commercial Sources

Avgas-Aviation Gasoline
Kero-Kerosene
Resid.F/O-Residual Fuel Oil
P.S.Elect.-Public Supply Electricity
Non-Comm.Fuels-Non Commercial Fuels

Source: National Council of Applied Economic Research

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